U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: TURBINE ENGINE CONTINUED ROTATION AND ROTOR LOCKING

Date: 2/14/97 **Initiated by:** ANE-110

AC No: AC 33.74/92 **Change:**

1. PURPOSE. This advisory circular (AC) provides guidance and acceptable methods, but not the only methods, that may be used to demonstrate compliance with the continued rotation and rotor locking requirements of part 33 of the Federal Aviation Regulations (FAR's). This AC is combining part 33 sections 33.74 and 33.92. This AC will be incorporated into AC 33.2, Aircraft Type Certification Handbook at a later date.

2. RELATED FAR SECTIONS.

a. Part 33, sections 33.74 and 33.92:	Airworthiness Standards: Aircraft Engines
b. Part 29, section 29.903 (c):	Airworthiness Standards: Transport Category Rotorcraft
c. Part 25, section 25.903 (c):	Airworthiness Standards: Transport Category Airplanes
d. Part 23, section 23.903 (e)(2):	Airworthiness Standards: Normal, Utility, and Acrobatic Category Airplanes

3. BACKGROUND. The subject of windmilling and rotor locking was identified as one where differences existed between the Joint Aviation Requirements-Engines (JAR-E) and part 33 of the Federal Aviation Regulations (FAR's). A study group composed of representatives of the Federal Aviation Administration (FAA), the Joint Aviation Authorities (JAA), Transport Canada and industry worked to produce a set of improved and harmonized requirements that was subsequently incorporated into part 33. This AC is intended to provide guidance in implementing these new harmonized requirements during certification.

4. DEFINITIONS. The following are defined for the purpose of this AC.

a. Continued rotation. A condition where there is rotation of any engine main

rotating system in an engine that has been shut down. Continued rotation can be caused by windmilling or mechanical effects, or a combination of both. Windmilling is rotation of a non-operating engine due to the airflow induced forces on the blades caused by the forward motion of the aircraft. Certain mechanical effects can also result in the continued rotation of a non-operating engine. An example of this includes the drive shaft clutch drag in some multi engine rotorcraft installations which may result in continued rotation of the engine after it has been shut down.

b. Rotor Locking Device. A mechanical device which will prohibit rotation of the engine rotor(s) when the engine is shut down.

5. CONTINUED ROTATION. The safety objective of section 33.74 is to ensure that an engine that continues to rotate after shut down will not create a hazard to the aircraft. The regulation states continued rotation of a turbine engine after shutdown, must not result in damage that could create a hazard to the aircraft during the period of flight which is likely to occur with that engine inoperative. Compliance to this requirement can be by test, analysis, or any method determined to be acceptable to the Administrator, and should represent the typical aircraft installation for that engine.

a. Applicability. The requirements of section 33.74 apply to turbine engines installed on subsonic or supersonic aircraft.

b. Failure conditions. Conditions that should be considered and addressed if determined to be applicable, should include but are not limited to items (1) through (4) of this paragraph. Consideration should be given to extended periods of continued rotation within the assumed one engine inoperative flight envelope following these failure conditions.

(1) complete loss of engine oil;

(2) rotor unbalance resulting from engine blade loss and subsequent rotor damage;

(3) windmilling in supersonic to subsonic transition flight conditions, and

(4) windmilling in supersonic flight conditions.

c. Hazard criteria. An engine that continues to rotate after shut down, and which results in any condition identified in section 33.75(a) through (c), is considered to be a hazard to the aircraft.

d. Typical installations. Maximum exposure time for continued rotation should be defined (e.g., per event, per life of the engine), and considered for the typical installation.

6. ROTOR LOCKING. The engine manufacturer has the option to incorporate a rotor locking device into the type design of the engine in order to comply with the safety objective defined in section 33.74. Activation of the device will stop and prevent subsequent continued rotation of the engine rotor(s) during flight when the engine is not operating. The device is part of the engine type design and should be subjected to same test criteria as other components in the engine. In addition, the rotor locking device should satisfy the operational and endurance test requirements identified in section 33.92 while the engine is subjected to the environmental conditions that result in the maximum rotational torque. The assessment of the maximum rotational torque should consider both damaged and undamaged engine rotors.

a. Reliability. The use of a rotor locking devise is expected to be infrequent, therefore, it should be shown that under normal engine operating conditions the device will not deteriorate beyond serviceable limits such that it fails to perform the intended function.

b. Design criteria.

(1) The rotor locking device should be designed in such a manner that it is possible for the flight crew to unlock the engine rotor(s) in order to initiate engine restart attempts. In the event these attempts are unsuccessful, it should be possible for the flight crew to relock the engine rotor(s).

(2) The effect on continued safe flight and landing in the event of an uncommanded activation of the rotor locking device in flight should be considered. In addition, consideration should be given to the single failure and engine isolation provisions of the appropriate aircraft FAR's.

(3) Environmental effects on rotor locking device performance should be evaluated for the engine operating envelope.

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